Job No.: 1505-102352 Ref.: JP05192223A
Translated from Japanese by the Ralph McElroy Translation Company
910 West Avenue, Austin, Texas 78701 USA

JAPANESE PATENT OFFICE

PATENT JOURNAL (A)

KOKAI PATENT APPLICATION NO. HEI 5[1993]-192223

Int. Cl.[5]:	A 45 D 34/04 A 61 K 7/00 B 05 B 5/025
Sequence Nos. for Office Use:	9165-4C 9153-4D
Filing No.:	Hei 4[1992]-188069
Filing Date:	July 15, 1992
Publication Date:	August 3, 1993
Priorty	
Date:	July 15, 1991
Country:	GB
No.:	9115276.9
No. of Claims:	21 (Total of 9 pages)
Examination Request:	Not filed

SKIN TREATMENT SYSTEM

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[There are no amendments to this patent.]

Abstract

Objective

To apply a skin treatment agent ordinarily found in a lotion or cream by lightly massaging or rubbing with the fingers, for example, in a substantially pure form.

Constitution

A method for directly distributing a skin treatment agent that electrostatically sprays a skin treatment agent onto the skin, and its device.

Effect

The skin treatment agent can be applied with good efficiency to the skin without using an aid, the sensation of application is improved, and skin irritation can be avoided.

Claims

1. A method for directly distributing a skin treatment agent to the skin, characterized by the fact that a skin treatment agent is electrostatically sprayed onto the skin.

2. The method of Claim 1, characterized by the fact that (a) a device equipped with (i) a reservoir containing the skin treatment agent to be distributed in an electrostatic spray form, (ii) at least one distribution means connected with the above-mentioned reservoir, (iii) a high-voltage generator to which power is supplied from a power source, and (iv) a control means for selectively applying a high voltage to the above-mentioned distribution means from the above-mentioned generator is prepared; and (b) the above-mentioned control means is operated so that the above-mentioned skin treatment agent may be directly, electrostatically sprayed onto a desired part of the skin from the above-mentioned distribution means.

3. The method of Claim 1 or 2, characterized by the fact that the above-mentioned skin treatment agent is selected from any of a moisturizer, shielding material, anti-sunburn material, post-sunburn care material, skin-conditioning agent, skin colorant, antimicrobial or antibacterial

material, insecticide, skin astringent, skin cleaner, remover of make-up or other cosmetics, massage oil, skin nutrient and treatment drug, eczema and skin damage treatment material, skin-whitening agent and drug for treating a pigment deposition abnormality, disinfectant and sterilizer, antiaging agent, and sensitive-skin treatment drug and mixtures thereof.

4. The method of any of Claims 1-3, characterized by the fact that the above-mentioned skin treatment agent is provided in a composition form containing one or more kinds solvents or diluents.

5. The method of any of Claims 1-4, characterized by the fact that the above-mentioned skin treatment agent is provided in a composition form with a resistivity of 10^4-10^{12} ohm·cm.

6. The method of any of Claims 1-5, characterized by the fact that the high voltage being generated by the above-mentioned high voltage generator is 2-20 kV.

7. The method of any of Claims 1-6, characterized by the fact that the above-mentioned skin treatment agent has a composition form being sprayed at an amount of 0.00001-0.5 mL/sec.

8. A device for directly distributing a skin treatment agent, characterized by including (a) a reservoir containing the skin treatment agent that can be electrostatically sprayed, (b) at least one distribution means connected with the above-mentioned reservoir, (c) a high voltage generator to which power is supplied from a power source, and (d) a control means for selectively applying a high voltage to the above-mentioned distribution means from the above-mentioned generator to electrostatically spray the above-mentioned skin treatment agent from the above-mentioned distribution means.

9. The device of Claim 8, characterized by further including a product supply means between the above-mentioned reservoir and the above-mentioned distribution means to transfer the skin treatment agent to be sprayed from the above-mentioned reservoir to the above-mentioned distribution means.

10. The device of Claim 9, characterized by the fact that the above-mentioned product supply means consists of a conduit being combined with a pump, if necessary.

11. The device of Claim 9, characterized by the fact that the above-mentioned product supply means is formed of a core material.

12. The device of any of Claims 8-11, characterized by the fact that the high voltage being generated by the above-mentioned high voltage generator is 2-20 kV.

13. A combination of the device of any of Claims 8-12 and an electrostatically sprayed composition that is composed of the skin treatment agent to be spread directly on the skin or includes said skin treatment agent.

14. An electrostatically sprayed composition, characterized by being composed of the skin treatment agent to be spread directly on the skin or containing said skin treatment agent.

15. The composition of Claim 14, characterized by the fact that the above-mentioned skin treatment agent is selected from any of moisturizer, shielding material, anti-sunburn material, post-sunburn care material, skin conditioning agent, skin colorant, antimicrobial or antibacterial material, insecticide, skin astringent, skin cleaner, remover of make-up or other cosmetics, massage oil, skin nutrient and treatment drug, eczema and skin damage treatment material, skin-whitening agent and drug for treating a pigment deposition abnormality, disinfectant and sterilizer, antiaging agent, and sensitive skin treatment drug and mixtures thereof.

16. The composition of Claim 14 or 15, characterized by including one or more kinds of solvents or diluents for the skin treatment agent that optionally includes one or more kinds of ordinary additives seen in ordinary product formulations for the body.

17. The composition of any of Claims 14-16, characterized by having a resistivity of 10^4-10^{12} ohm·cm.

18. The composition of any of Claims 14-17, characterized by further including a resistivity and/or viscosity adjustor.

19. The composition of any of Claims 14-18, characterized by being substantially nonaqueous or containing less than 10 wt% water.

20. A use of an electrostatic spray for distributing a skin treatment agent directly to the skin.

21. The use of Claim 20, characterized by using the device of any of Claims 8-12.

Detailed explanation of the invention

[0001]

Industrial application field

The present invention pertains to a system for directly distributing a skin treatment agent to the skin. In particular, the present invention pertains to a method and a device for applying such a drug to the skin using an electrostatic spray principle.

[0002]

Many ordinary skin treatment products are liquid, viscous, or semisolid products with a lotion or cream form, for instance, and have been applied by lightly massaging or rubbing them in with the fingers. In manufacturing a cosmetically acceptable product, since a relatively large amount of additives, that is, materials of more than one kind of active skin treatment substances to be spread are required, the above-mentioned well-known distribution system requires relatively great effort, there is a waste of cosmetic raw materials, and there is a limit in the efficiency when a desired active substance is distributed on a desired part. Controlling the amount being applied is difficult and limited, and the application of the product itself requires time and is complicated in many cases.

[0003]

If a meaningful amount of stabilizing components such as surfactants, polymers, and preservatives exists in the product, the feel is deteriorated in many cases, and for example, a user can experience stickiness, sliminess, and, sometimes, sharp irritation. It is strongly recieved, especially when there is skin damage or infection, and, as such, in many cases, it is not particularly desirable to apply a treatment agent by massaging or rubbing it in.

[0004]

The skin is actually a very complicated substance and has many important characteristics to be considered when an optimum system for distributing an active substance for make-up or treatment on the skin. The skin has a polysurface having both lipophilicity and lipophobicity, so that the skin can "respire" or can discharge vapor and can function as an effective barrier to water, dyes, and other undesirable substances. One especially important physical characteristic of the skin is its very rough surface area, and it becomes a problem when a desired active skin treatment substance is to be well applied so that it uniformly covers the skin 100%.

[0005]

In addition to the above-mentioned system for distributing a skin treatment agent, there are some well-known examples in which an active skin treatment substance is distributed using an aerosol spray. Two of these examples are the sprays for treating sunburn and sprains and other

sports injuries. However, the aerosol well known in the corresponding field for distributing products for the body has several drawbacks. For example, the type of products and active substance in an effective aerosol spray are limited, and the use of the aerosol itself is very ineffective or wasteful when its application is not targeted, or the active substance is lost in the air or is unexpectedly sprayed into the air or sometimes contaminates the eyes, face, or other body parts of a user, causing a respiratory or other health problems. Furthermore, an aerosol spray is noisy, and in many cases, it is usually necessary to use a spray agent, which is a volatile organic compound. It is now recognized that the spray agent has a negative influence on the environment and is sometimes harmful to health, and is prohibited by law in many countries in the world. Furthermore, it is considered that the use of the aerosol to distribute a skin treatment agent is much less effective than the distribution of the prescription through an ordinary massage or rubbing-in, in terms of uniformity and coverage of a rough skin surface.

[0006]

In totally different technical fields, the electrostatic spray principle of liquid and solid materials is also well known. In this technique, a formulation to be sprayed is raised to a high potential in a spray nozzle, and the formulation is sprayed as a mist of small charged drops. These small charged drops seek the closest grounded object to discharge their electric charges, and the object can be constituted as a desired spray target. Up to now, the electrostatic spray technique has been proposed for only large-scale industrial or agricultural usage, especially to distribute reactive substances such as paints, adhesives, and other surface coatings and to distribute insecticides and other agricultural formulations on a large scale. As examples presented in this field, British Patent Application Nos. 1393333, 1569707, and 2092025, European Patent Application Nos. 029301 and 253539, and Patent No. WO-A-85/00761 can be mentioned. The contents of these patents presented as references constitute part of this specification.

[0007]

More recently, some proposals for using the well-known electrostatic spray principle to distribute specific materials in special uses other than the above-mentioned applications have been made.

[0008]

In European Patent No. 224352, the use of the electrostatic spray for distributing a medical activator to the eyes instead of ordinary ophthalmic treatments using eyedrops is proposed.

[0009]

Japanese Kokai Patent Application No. Sho 56[1981]-97214 (1981) proposes the use of the electrostatic spray to apply a particulant (that is, solid particle) colorant to hair for the surface coating of the hairs.

[0010]

Furthermore, in U.S Patent No. 4776515, an electrodynamic-particulate negative-ion generator for spraying various liquids, especially water, sometimes alcohol, perfume, ammonia, liquid drugs, and surfactants is proposed, though little is said about it. The purpose of the system presented here is to give mists of negatively ionized liquid particles containing no ozone (assuming that the material to be sprayed can be ionized) and to immediately generate a uniform aerosol that is dispersed and spread far in an open area such as a room where the mist-generating device is operated. It is especially useful in large public areas such as hospitals, restaurants, and offices. It is apparent that this system is inappropriate for small scale use on the of the body, and its main purpose is contradictory to the principle of finding solutions to the problems of the above-mentioned prior art.

[0011]

As a result of recognition and understanding of the problems, disadvantages, and limits of the above-mentioned well-known techniques, and through sufficient experiments, these inventors found a system that could effectively use the electrostatic spray principle by distributing a skin treatment agent directly onto the skin. The present invention provides a device that is effective for such a distribution prescription in terms of technique and cost, which is safe, has a wide range of consumer applicability and appeal, and solves or at least improves most of the problems of the prior art, though all of them are not solved, and its method.

[0012]

A first embodiment of the present invention provides a method for directly distributing a skin treatment agent onto the skin characterized by the fact that a skin treatment agent is electrostatically sprayed onto the skin.

[0013]

More specifically, in the method of this embodiment of the present invention, preferably, (a) a device equipped with (i) a reservoir containing the skin treatment agent to be distributed in an electrostatic spray form, (ii) at least one distribution means connected with the above-mentioned reservoir, (iii) a high voltage generator to which power is supplied from a power source, and (iv) a control means for selectively applying a high voltage to the above-mentioned distribution means from the above-mentioned generator is prepared, and (b) the above-mentioned control means is operated so that the above-mentioned skin treatment agent may be electrostatically sprayed directly onto a desired part of the skin from the above-mentioned distribution means.

[0014]

A second embodiment of the present invention provides a device for directly distributing a skin treatment agent characterized by including (a) a reservoir containing the skin treatment agent that can be electrostatically sprayed, (b) at least one distribution means connected with the above-mentioned reservoir, (c) a high voltage generator to which power is supplied from a power source, and (d) a control means for selectively applying a high voltage to the above-mentioned distribution means from the above-mentioned generator to electrostatically spray the above-mentioned skin treatment agent from the above-mentioned distribution means.

[0015]

A third embodiment of the present invention provides a combination of the above-mentioned device and an electrostatically sprayed composition that is composed of the skin treatment agent to be spread directly on the skin, or includes said skin treatment agent.

[0016]

As a result of the investigation leading to the present invention by these inventors, these inventors further found that, when an electrostatic spray was used to distribute a skin treatment agent, there were several unexpected effects [seen] on a cross section of the skin area by a surface profilometry investigation, compared with well-known application prescriptions. The electrostatic spray effect on the skin cross section after applying products shows additional unexpected advantages of this new method, especially in terms of coverage of the skin surface and uniformity when applying. These advantages will be mentioned later in detail referring to the attached figures.

[0017]

The main embodiments of the present invention have been defined. Next, preferred embodiments and various optional characteristics and features of the present invention are explained in detail.

[0018]

The skin treatment agent that can be distributed using the system of the present invention can be any of a very wide range of materials, especially optional skin treatment materials that have already been used in ordinary lotion or cream products that are massaged or rubbed in. Examples of the skin treatment agents are well known in the corresponding field, and they can be distributed alone or in combination.

[0019]

As examples of the active surface treatment substance suitable for the distribution using the present invention, the following can be mentioned.

[0020]

1. Moisturizer, for example, 2-hydroxyalkanonic acid and its acid-soap composite, polyols such as glycerin and glycol, 2-pyrrolidone-5-carboxylic acid, and other softening agents or moisturizers.

[0021]

2. Shielding agent (occlusive materials), for example, shielding oil.

[0022]

3. Anti-sunburn material, for example, anti-sunburn material, especially UV-absorbing anti-sunburn material.

[0023]

4. Post-sunburn care material, for example, sunburn treatment material.

[0024]

5. Skin-conditioning agent, for example, skin-smoothing or -softening drug.

[0025]

6. Skin colorant, for example, artificial suntan product such as a composition containing dihydroxyacetone (DHA).

[0026]

7. Antimicrobial or antibacterial material.

[0027]

8. Insecticide.

[0028]

9. Astringent, for example, hydrolyzable tannin, phenolic acids combined with tannins, flavonoid compounds, natural extracts with a skin astringent effect, organic and inorganic astringents (especially, salts of aluminum, zinc, iron(III), copper, or silver).

[0029]

10. Skin cleaner and remover of make-up or other cosmetics,.

[0030]

11. Massage oil.

[0031]

12. Skin nutrient and treatment drug.

[0032]

13. Eczema and skin damage treatment material

[0033]

14. Skin-whitening agent and drug for treating a pigment deposition abnormality, for example, drug for treating freckles.

[0034]

15. Disinfectant and sterilizer.

[0035]

16. Antiaging agent for treating wrinkles or preventing their formation.

[0036]

17. Sensitive skin treatment drug.

[0037]

One special advantage of products that can be distributed by the present invention is that at least part or all of additive components required to be included in conventional skin treatment products are not used. In other words, one or more kinds of active skin treatment components required can be distributed in a an unmixed or substantially unmixed form, while including only a relatively small amount of additives. These optional auxiliary components, especially solvents or diluents, can also be used within the range of the present invention, if desired or necessary.

[0038]

In actuality, in order to use the skin treatment agent in the present invention, it is preferably provided in the form of a composition that dissolves an active skin treatment substance or is soluble in it or includes one or more kinds of solvents or diluents miscible with it. Appropriate solvents are well known in the corresponding field, and for example, alcohols and polyols such as ethanol, isopropyl alcohol, propylene glycol, dipropylene glycol, phenylethyl alcohol, glycerol, 1,3-butadienediol, 1,2-propanediol, and isoprene glycol can be mentioned.

[0039]

It is preferable for the composition being distributed by the present invention to be a liquid. Optional ordinary additives included are preferably liquids at room temperature; however, since they are used in small amounts, if necessary, they may also be solids as long as the electrostatic spray of the composition is not damaged.

[0040]

In general, the entire essential requirement of effective compositions for the present invention is that they can be electrostatically sprayed.

[0041]

The generally required (as will be mentioned later) basic characteristic carefully selected or adjusted, if necessary, in these materials or compositions that can be electrostatically sprayed is resistivity. The resistivity is preferably 10^4-10^{12} ohm·cm, more preferably 10^5-10^{10} ohm·cm. A resistivity lower than 10^4 can sometimes be used. A resistivity higher than 10^{12}, for example, up to about 10^{14} or higher can also be used, and such a value is difficult to measure using an ordinary inexpensive ohm meter. The resistivity is usually measured at 25°C using an ordinary device and standard method.

[0042]

The composition being distributed using the present invention is preferably nonaqueous, however a small amount of water, such as less than 10 wt%, preferably less than 5 wt%, and more preferably less than 1 wt%, can also be included. The reason for this is that, since the

resistivity is low, compositions with a large amount of water are generally difficult to spray effectively using an electrostatic means.

[0043]

The composition being applied to the skin according to the present invention is generally left there as it is, and it is preferable to remove inappropriate components or components that can have a harmful effect on the skin when they remain on it from the composition being applied.

[0044]

As has already been mentioned above, it is necessary to adjust the resistivity by adding one or more kinds of resistivity-adjusting material in accordance with the composition or material to be distributed; however, its example and appropriate amount are well known to the party concerned and can also be easily derived by a simple experiment. In order to lower the resistivity of a given material or composition, an alcohol, for example, a polar substance such as ethanol can be used. As another resistivity-adjusting material, salts, for example, charged species such as sodium chloride or salts ordinarily used in products for the body or a buffer solution in a pharmaceutical formulation can be mentioned.

[0045]

In addition to the resistivity, viscosity is another parameter of the composition that must be carefully selected and adjusted.

[0046]

Materials with a wide range of viscosity are appropriate for the present invention, and the viscosity (at 25°C) is appropriately about 0.1-50,000 mPas, preferably about 0.1-10,000 mPas, and more preferably about 0.5-5,000 mPas. If desired and if necessary, one or more kinds of viscosity adjustors can be included. As examples of the viscosity adjustor, salts (for example, alkali metal or ammonium halide salts), polymers, ordinary tackifiers, and oil and polar oil tackifiers (for example, cosmetic oils, waxes, and glycerides), and appropriate amphiphiles with melting points higher than 20°C can be mentioned.

[0047]

The viscosity can be used as a parameter for controlling the amount of effective substance or therapeutic drug applied to a desired part, as seen from several embodiments of the system of the present invention, if it is actually inversely proportional to the flow rate of the material being discharged from the distribution means. For example, an optimum amount of a specific effective substance or therapeutic drug being distributed can depend on a specific distribution prescription or on the habit or need of a user; however, in this case, a self-adjusting mechanism for the amount being applied can result by carefully selecting the viscosity of the material being sprayed.

[0048]

The hardware and electric elements and circuits used in the present invention can have optional appropriate constitutions and designs. In the electrostatic spray technique field, there are many examples of an appropriate device usable in the present invention, and the presented contents of such a device or its characteristics can be applied alone or in combination to the spray system of the present invention.

[0049]

As examples of appropriate electrostatic spray hardware, in addition to the references of the above-mentioned prior art, British Patent Application Nos. 2061769 and 2073052 and European Patent Application Nos. 031649, 132062, 163390, 171184, 234842, 243031, 368494, 441501, 468735, and 468736 can be mentioned, and it is assumed that the contents of these patents presented as references constitute part of this specification.

[0050]

As can be understood by the party concerned, specific structural characteristics and designs and electric and other operating parameters of these devices can be selected or adjusted as needed in the present invention in accordance with the desired functional characteristics, being controlled by the composition or material to be sprayed and/or by the user or the demands of a user.

[0051]

As the characteristics of the device of the present invention that can be selected and/or adjusted in this manner, for example, the voltage being generated by the high voltage generator and the power source, the intensity of an electric field in the product distribution means or its vicinity, the flow rate of the product that is sent from the reservoir to the distribution means and sprayed from the distribution means, the size and constitution of the distribution means itself, and the constitution and characteristics of an optional product supply mechanism used between the reservoir and the outlet of the distribution means.

[0052]

In a preferable embodiment of the present invention, the voltage being generated by the high voltage generator to which power is supplied from the power source is preferably about 2-20 kV, more preferably about 5-16 kV. The most appropriate voltage for a given system can depend on the product to be sprayed and other parameters, and all of them are generally selected so that a generally optimized system may result.

[0053]

The intensity of an electric field for the spray action of the electrostatic device depends largely on the voltage being applied. However, the intensity of the electric field, can be controlled or adjusted if necessary, by changing the constitution or form of a nozzle and/or using an electric field-reinforcing electrode, as is well known in the above-mentioned field.

[0054]

The optimum flow rate of the material to be sprayed generally depends on the composition of the product itself, for example, the concentration of active components being applied, and can be appropriately selected based on the composition so that the feel is not deteriorated. Furthermore, as has already been mentioned for the viscosity of the material that can be sprayed, an appropriate flow rate can also be selected in accordance with a specific distribution prescription and/or the habits or needs of a user. For example, the flow rate of the composition being distributed according to the embodiments of the present invention is

preferably about 0.00001-0.5 mL/sec, more preferably about 0.0001-0.1 mL/sec for each distribution means.

[0055]

The size and constitution of one or more distribution means in the device of the present invention can have optional appropriate forms, and they can also be selected here in relation to other parameters so that an optimally functioning electrostatic spray system may result. In general, it is preferable for (in case several distribution means exist, each of them) the distribution means to have a nozzle formed of an insulating or semi-insulating material such as plastics or various polymers, as is well known in the corresponding field.

[0056]

As a preferable form of the nozzle, a conduit for transporting the product to be sprayed is an orifice at the tip of the nozzle, and the product is initially sprayed in a stream from the orifice and eventually dispersed as a mist of small charged drops in any case. The orifice has a diameter of preferably about 400 μm or less, more preferably about 350 μm or less. More preferably, the orifice has a diameter of about 125-250 μm.

[0057]

As another embodiment, as described in European Patent Application No. 0243031, the nozzle has a crown-shaped structure at its tip and includes a narrow conduit through which a product is guided to the tip by capillary action. It is assumed that the contents of the above patent presented as a reference constitute part of this specification. In this constitution, the intensity of an electric field in several spray parts of the nozzle is sufficiently large for an electrostatic spray of the product at several positions from the tip of the nozzle, compared with the remaining edge part area of the nozzle.

[0058]

It can be advantageous for the distribution means to include a measurement means, a metering mechanism for distributing a prescribed amount of material from the nozzle (each of

them, in case several materials exist). Such a means can be effective in relation to the system having a controlled flow rate, for instance.

[0059]

In a preferred embodiment of the device of the present invention, each above-mentioned distribution means is connected, preferably hydraulically connected with one reservoir or (for example, in case two or more kinds of materials or compositions are sprayed from the same device or the same distribution means) several reservoirs by a product supply means.

[0060]

In a preferred embodiment, such a supply means can include a core material (wick) such as a porous core material, and the product to be sprayed passes through the core material and reaches a high-intensity electric field, at which point it is dispersed as a mist of small charged drops or particles. In another preferred embodiment, the supply means can include a hollow conduit through which the composition passes by capillary action. Furthermore, in another modified embodiment, for example, a system requiring an especially high flow rate can be equipped with a special supply means such as a pump. Usually, the pump can be used with any of the above-mentioned other types of supply means; however, more favorably, it is a simple mechanical device for applying pressure to the reservoir containing the composition to be sprayed so that the composition may be expelled from the reservoir to the distribution means.

[0061]

As is well known in the corresponding field, it is preferable to include a trigger (that is, a manual control means) for selectively applying a high voltage to the distribution means from the generator or an automatic control means to electrostatically spray an active substance or therapeutic drug onto the hair and/or the scalp. However, as can be understood by the party concerned, for example, other optional appropriate control means for automatically controlling the operation of the system can also be used.

[0062]

Skin surface profilometry investigation

In particular, for the comparison of the effects of the conventional application prescription (rubbing-in and pump spray) and the application prescription (electrostatic spray) of the present invention, skin surface profilometry was used, and the effect of application of a liquid cosmetic composition to the skin in vivo was investigated. The method and principle of skin surface profilometry are described in the following two references, for instance, and it is assumed that their contents are presented as references that constitute part of this specification.

[0063]

1. "Topographies of dry skin, non-dry skin, and cosmetically treated dry skin as quantified by skin profilometry," T.H. Cook & T.J. Craft; J. Soc. Cosmet. Chem., 36, 143-152 (1985); 2. "Assessment of skin conditions using profilometry," Peter L Dorogi & Marek Zielmiski; Cosmetrics & Toiletries, 104, (March 1989).

[0064]

The following production application prescriptions were investigated.

[0065]

(i) Application/rubbing-in with the fingers

(ii) Small drops sprayed from the pump spray

(iii) Small charged drops from the electrostatic spray

[0066]

Experiments:

Using a silicone-rubber contact-pressure material (SILFLO (trademark) made by Flexico Developments Ltd.), negative replicas of the skin surface before and after applying a product were obtained. The replicas were sampled using three parts, at maximum (each part was 4 x 3 cm), per one arm from the flat side of the hand to the forearm. The parts were separated from each other by 2-3 cm and were separated from the wrist and the back of the elbow by at least

4 cm. Before forming the replicas, each part was equilibrated at 21°C/50% relative humidity for 15 min.

[0067]

Using a SURFCOM 113B profilometer made by Advanced Metrology System Ltd., the characteristics of the replica surface were analyzed. A needle with a radius of 5 μm crossed the sample surface at a needle pressure of 0.4 g. The vertical motion of the needle was measured, and the accumulated data were electronically converted so that a standard roughness parameter was obtained. The sample was measured by rotating them at 45°, and an average of 8 tracks with a length of 10 mm was calculated.

[0068]

Two parameters were recorded.

[0069]

R_a – Numerical average of the vertical change from the calculation reference line (hereinafter, the change of mountains and valleys to the "average reference line"), and R_{max} – Maximum height from the mountain to the valley in the entire scan.

[0070]

The replica sampled before applying the product was used as a comparison. The product was applied at about 1 mg/cm^2 (an ordinary skin-product load) and 11 mg/cm^2 (a minimum pump spray dosage). After 3 min of the product application, the replica was sampled. Using a single testee, a continuous test was carried out for three days.

[0071]

Two kinds of formulations were tested.

[0072]

Product A: 65% DC344 (silicone oil made by Dow-Corning Co.), 5% ESTOL 1514 (isopropyl myristate made by Unichema Co.), and 30% ethanol.

[0073]

Product B: Pure perfume oil

[0074]

In the electrostatic spray prescription of the present invention, a flow rate of 2 g/min was given, and a flow rate of 0.004 g/min was given. Two different prototype devices of a preferred embodiment of the present invention were used. The electric hardware and spray parameters of said devices were optimized so that the spray might be finely dispersed in a wide range in both cases. In an ordinary spray prescription, a conventional fine hair spray-type pump spray obtainable from Cope Allman International Dispenser Group was used.

[0075]

Results:

The results are shown below.

[0076]

(Table 1)

			平均値及び対照に対する%変化			
			Ra (μm)	%変化	Rmax (μm)	%変化
(a) 低製品負荷 (1 mg/cm²)						
製品A	擦り込み	対照	13.8		139.8	
		処置	13.2	−4	114.8	−18
製品A	静電吹付け1*	対照	12.2		124.8	
		処置	15.8	+30	159.2	+28
製品B	擦り込み	対照	17.4		212.6	
		処置	13.4	−23	136.8	−36
製品B	静電吹付け2**	対照	12.2		171.6	
		処置	12.8	+5	148.4	−14
(a) 高製品負荷 (11mg/cm²)						
製品A	ポンプスプレー	対照	11.8		112.6	
		処置	14.6	+2	185.2	+64
製品A	静電吹付け1	対照	13.8		142.0	
		処置	14.0	+1	156.6	+10

* 流量 2g/分
**流量 0.004g/分

Key:
1 % change to the average value and the comparison
2 % change
3 (a) Low product load (1 mg/cm^2)
4 Product __
5 (a) High product load (11 mg/cm^2)
6 Rubbing-in
7 Electrostatic spray 1*
8 Electrostatic spray 2**
9 Pump spray
10 Treated control
11 * Flow rate: 2 g/min
** Flow rate: 0.004 g/min

[0077]

Conclusion:

The skin surface, as described in the above-mentioned reference 2, shows fine grooves and a layered structure containing fine grooves. The roughness parameters R_a and R_{max} quantify this complicated surface.

[0078]

It is thought that the effects on the roughness parameters of spreading various application prescriptions can be classified into various categories as shown in Figures 1(a)-(d).

[0079]

Figure 1(a) shows an untreated skin surface in which the comparative value for R_a and R_{max} is prescribed.

[0080]

Figure 1(b) shows that the coating of the product is uniform, and R_a and R_{max} are changed only slightly or are not changed at all.

[0081]

Figure 1(c) shows the case where mainly valleys are coated and R_a and R_{max} are meaningfully decreased.

[0082]

Figure 1(d) shows the case where mainly mountains are coated and R_a and R_{max} are meaningfully increased.

[0083]

Compared with the above-mentioned model, the decrease of R_a and R_{max} detected after applying the product with the fingers by rubbing-in agrees with the behavior shown in Figure 1(c), that is, the state in which the valleys are preferentially filled and the mountains remain relatively uncoated.

[0084]

In an ordinary pump spray tested only with a high product load, R_a and R_{max} are increased, and it shows that mainly the mountains are coated (Figure 1(d)).

[0085]

The electrostatic application of the present invention gave a different response. At a low product load, product A increases R_a and R_{max}, and it shows the behavior shown in Figure 1(d). In other words, the mountains are preferentially covered. At a higher product load, R_a and R_{max} are only slightly affected, and it shows the behavior shown in Figure 1(b). In other words, both the mountains and the valleys are covered.

[0086]

From the above-mentioned results, the electrostatic application prescription given by the present invention supports the knowledge that, when the skin requires treatment for its protection, conditioning, or therapy, especially for skin treatment products that require 100% and/or uniform coating unparalleled usefulness can result when compared with ordinary application methods.

[0087]

It is thought that the differences seen between the electrostatically sprayed products are due to the differences among the product types (for example, viscosity, wettability, and volatility) and the distribution parameters (for example, small drop speed, electric charge, and size). For product B, with a lower volatility, since it might have a higher capture of the product, a relatively excellent coating apparently resulted, even at a low product load.

Brief description of the figures

Figures 1(a)-(d) are schematic diagrams showing the skin surface cross section of untreated and treated skin with a therapeutic drug in the prescriptions of the present invention and the prior art.

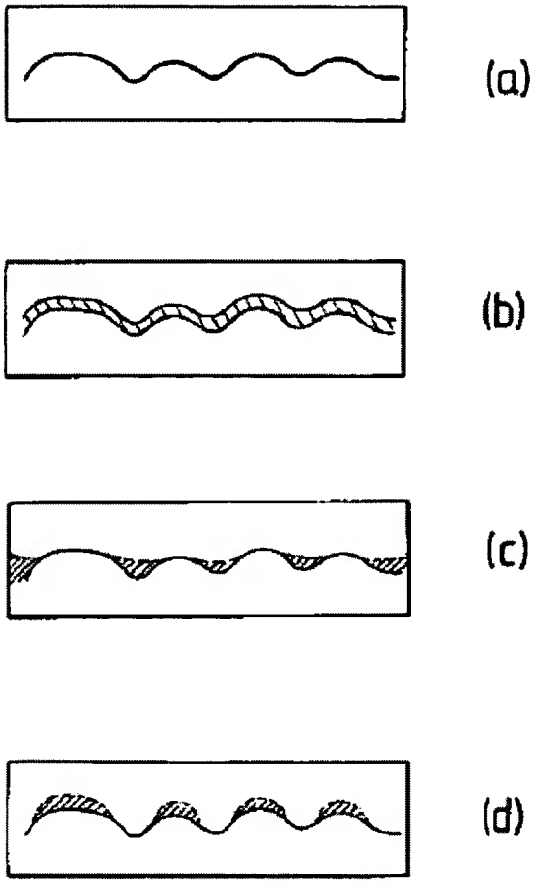

Fig. 1